

WS-4-5



WorldSID tests



Autoliv Research

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Test program 2009 – 2010



Car-to-Car & SUV-to-Car
WorldSID 5% & 50%-ile



Sled test – EuroNCAP pole
WorldSID 50%-ile



High severity MDB
WorldSID 5% & 50%-ile



Sled test – EuroNCAP MDB
WorldSID 50%-ile

Car-to-Car 90° lateral tests – Front seat WS50%



Front-Seat	Head Acc. [g]	Shoulder Dy [mm]	Thorax Dy [mm]	Thorax VC	Abdomen Dy [mm]	Abdomen VC	Low Spine Acc. [g]	Pubic Force [kN]*	Pelvis Acc. [g]
Car-to-Car 55 km/h	43	34	15	0,13	20	0,16	48	1,4	53
Car-to-Car 70 km/h	67	46	35	0,71	36	0,73	92	1,9	117
Car-to-Car 70 km/h	95	N/A	25	0,39	39	0,53	78	2,9	124
Car-to-Car 80 km/h	108	51	43	0,95	39	0,71	146	2,0	107

*Pubic force extrapolated from LH Iliac force

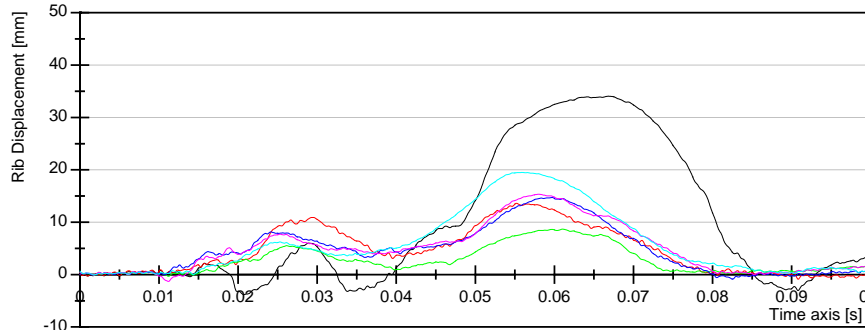
Car-to-Car 90° lateral tests – Rear seat WS5%



Rear-Seat	Head Acc. [g]	Shoulder Dy [mm]	Thorax Dy [mm]	Thorax VC	Abdomen Dy [mm]	Abdomen VC	Low Spine Acc. [g]	Pubic Force [kN]	Pelvis Acc. [g]
Car-to-Car 55 km/h	42	16	13	0,13	26	0,42	59	1,0	52
Car-to-Car 70 km/h	59	17	26	0,45	41	0,85	89	N/A	43
Car-to-Car 70 km/h	126	30	21	0,36	51	1,54	107	N/A	101
Car-to-Car 80 km/h	66	21	29	0,45	37	1,21	85	N/A	102

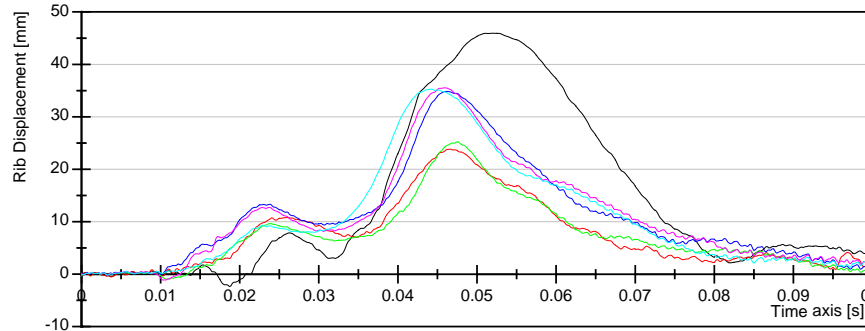
WorldSID 50%-ile rib displacement (d_{yi}) [mm]

55 km/h



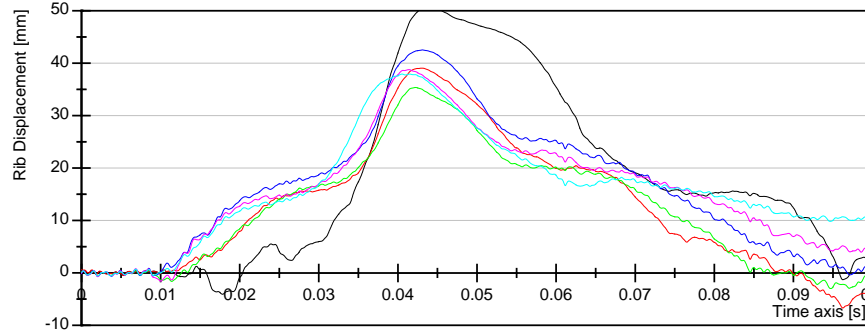
- T-09059181 - Shoulder Rib Left Disp.
- T-09059181 - Thorax Rib 1 Left Disp.
- T-09059181 - Thorax Rib 2 Left Disp.
- T-09059181 - Thorax Rib 3 Left Disp.
- T-09059181 - Abdomen Rib 1 Left Disp.
- T-09059181 - Abdomen Rib 2 Left Disp.

70 km/h

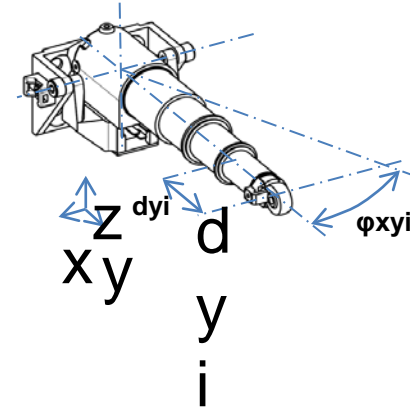


- T-09059182 - Shoulder Rib Left Disp.
- T-09059182 - Thorax Rib 1 Left Disp.
- T-09059182 - Thorax Rib 2 Left Disp.
- T-09059182 - Thorax Rib 3 Left Disp.
- T-09059182 - Abdomen Rib 1 Left Disp.
- T-09059182 - Abdomen Rib 2 Left Disp.

80 km/h

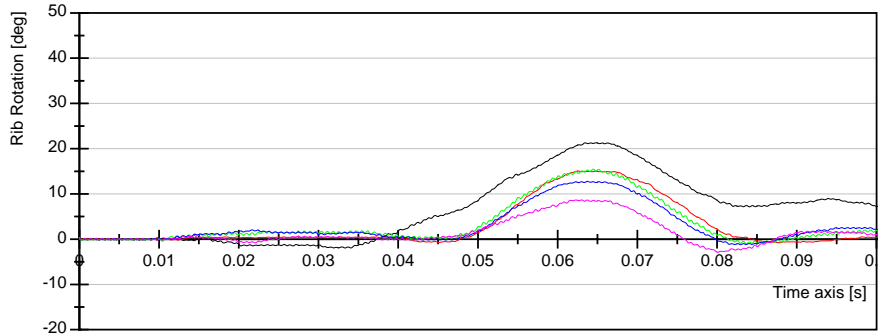


- T-09059183 - Shoulder Rib Left Disp.
- T-09059183 - Thorax Rib 1 Left Disp.
- T-09059183 - Thorax Rib 2 Left Disp.
- T-09059183 - Thorax Rib 3 Left Disp.
- T-09059183 - Abdomen Rib 1 Left Disp.
- T-09059183 - Abdomen Rib 2 Left Disp.



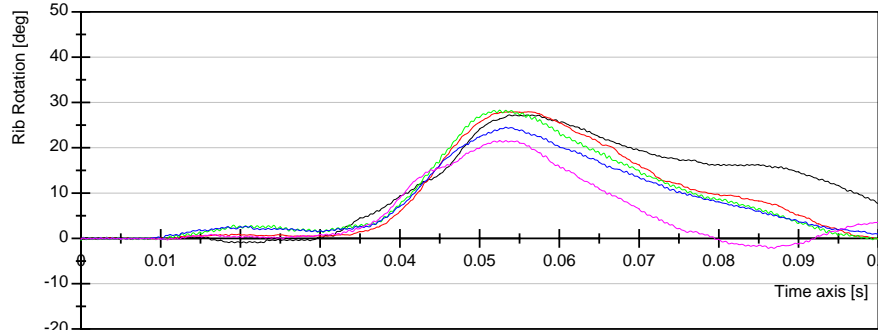
WorldSID 50%-ile rib rotation (ϕ_{xyi}) [deg]

55 km/h



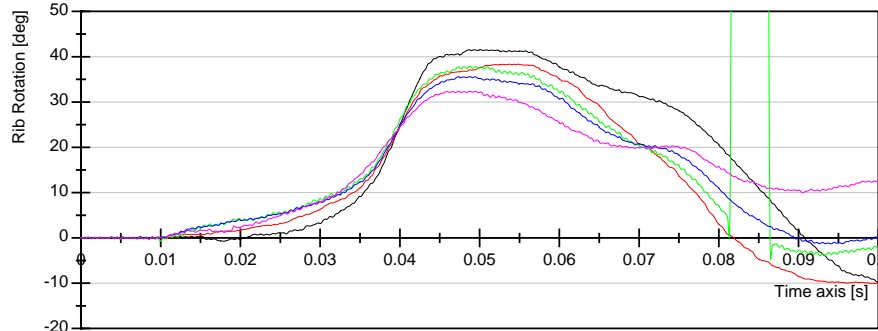
- T-09059181 - Shoulder Rib Left Rot.
- T-09059181 - Thorax Rib 1 Left Rot.
- T-09059181 - Thorax Rib 2 Left Rot.
- T-09059181 - Thorax Rib 3 Left Rot.
- T-09059181 - Abdomen Rib 2 Left Rot.

70 km/h

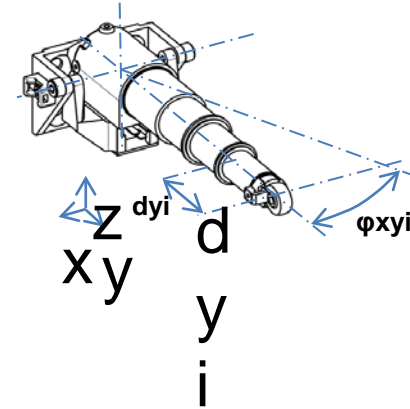


- T-09059182 - Shoulder Rib Left Rot.
- T-09059182 - Thorax Rib 1 Left Rot.
- T-09059182 - Thorax Rib 2 Left Rot.
- T-09059182 - Thorax Rib 3 Left Rot.
- T-09059182 - Abdomen Rib 1 Left Rot.

80 km/h

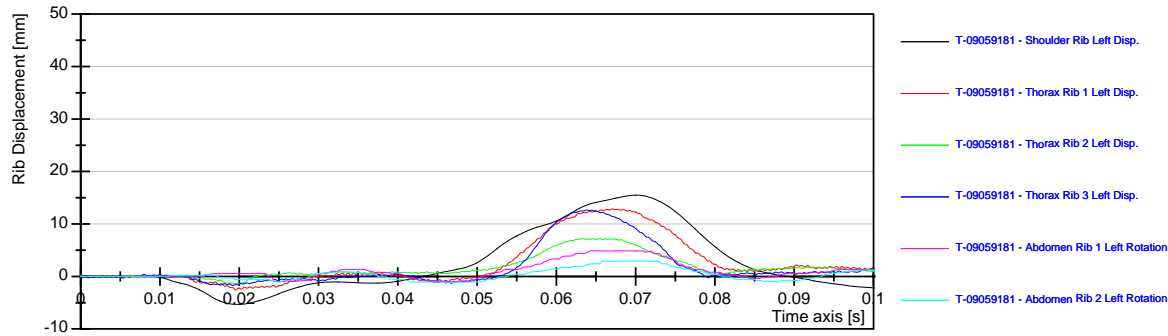


- T-09059183 - Shoulder Rib Left Rot.
- T-09059183 - Thorax Rib 1 Left Rot.
- T-09059183 - Thorax Rib 2 Left Rot.
- T-09059183 - Thorax Rib 3 Left Rot.
- T-09059183 - Abdomen Rib 2 Left Rot.

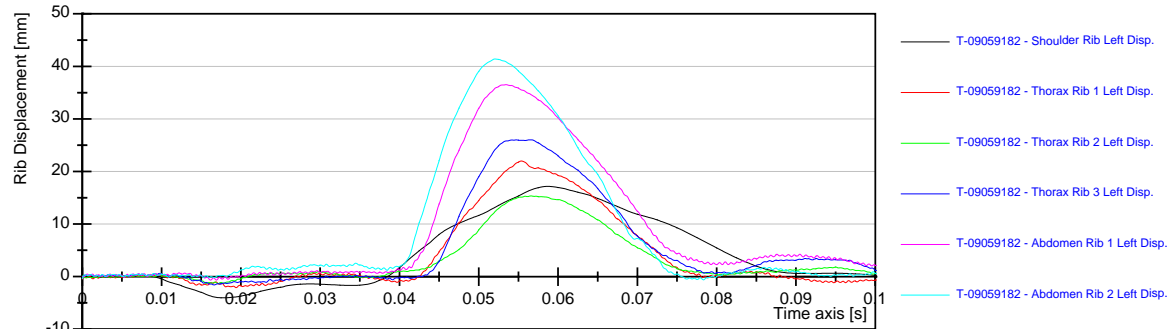


WorldSID 5%-ile rib displacement (dy_i) [mm]

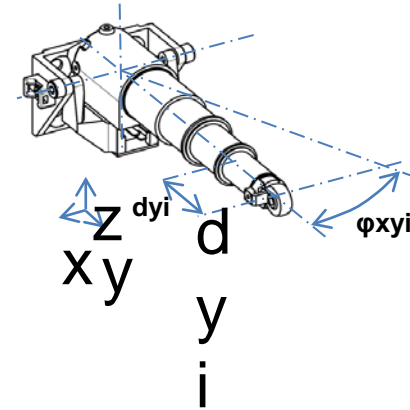
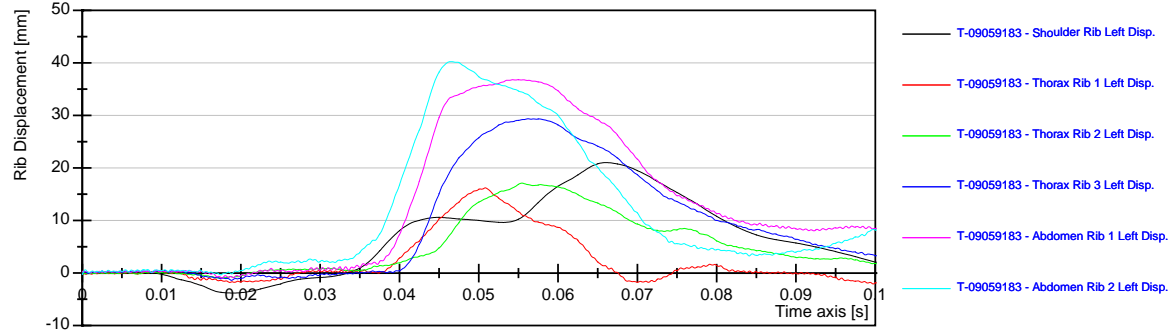
55 km/h



70 km/h

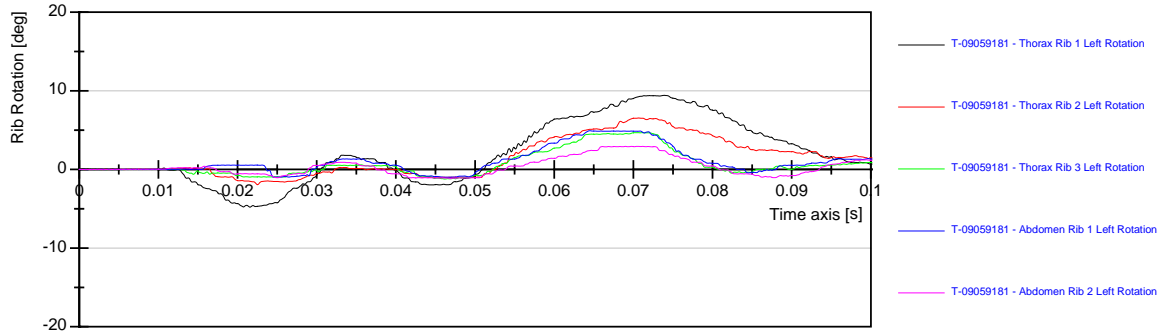


80 km/h

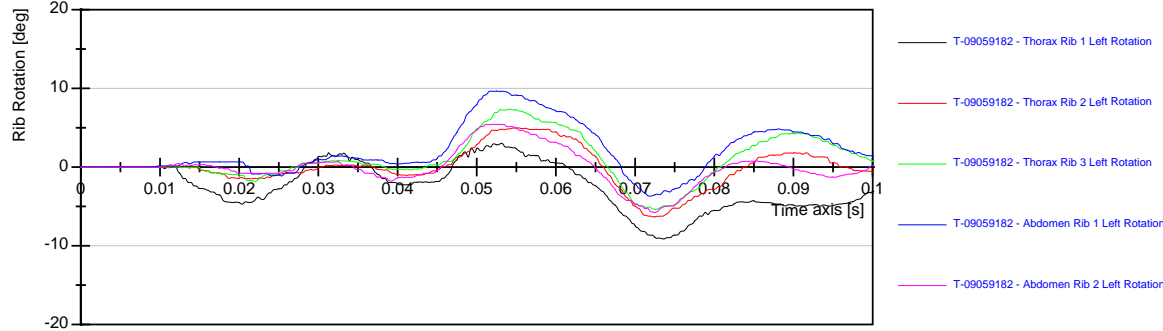


WorldSID 5%-ile rib rotation (ϕ_{xyi}) [deg]

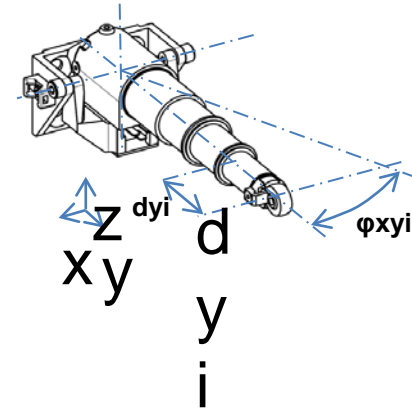
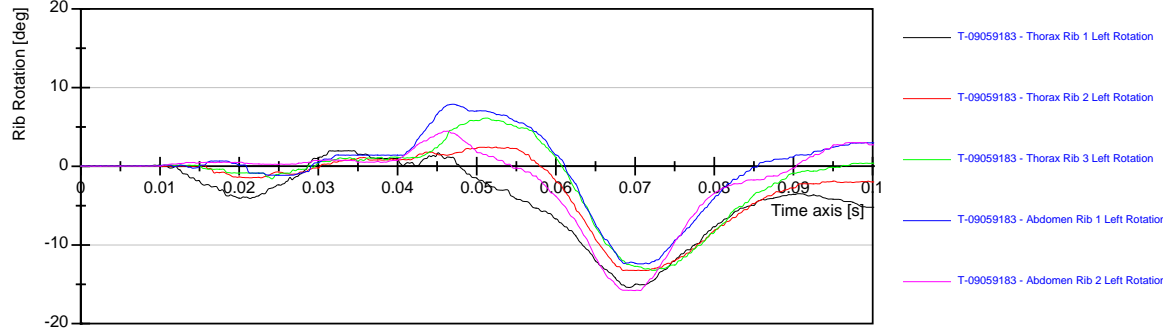
55 km/h



70 km/h

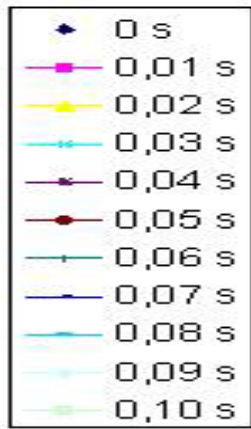


80 km/h

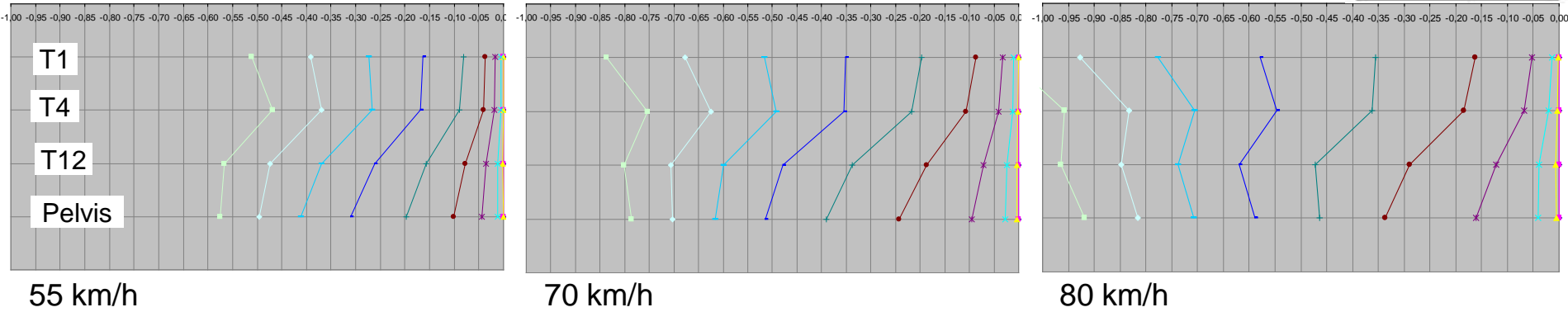


Dummy kinematics (same target car)

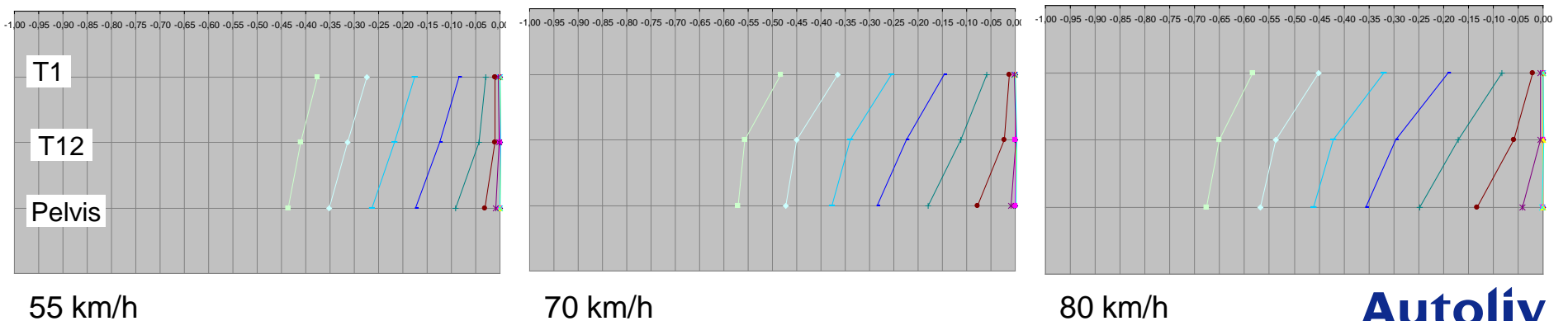
Global coordinates (shows total dummy travel)



Car-to-Car Front seat



Car-to-Car Rear seat



Car-to-Car 80 km/h



**Near-side event separated in time from far-side event
=> Bilateral loading of thorax and abdomen**

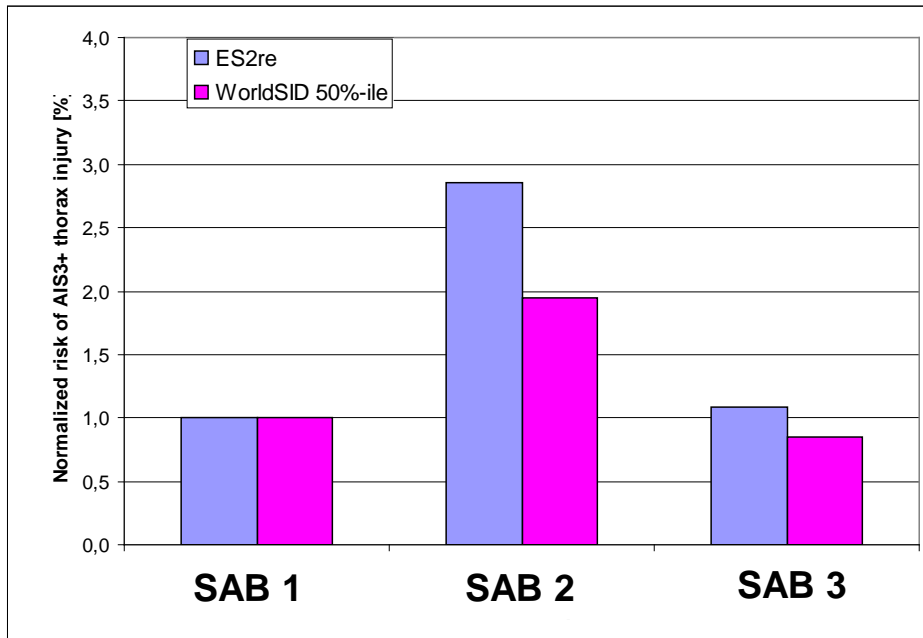
WorldSID Sled tests



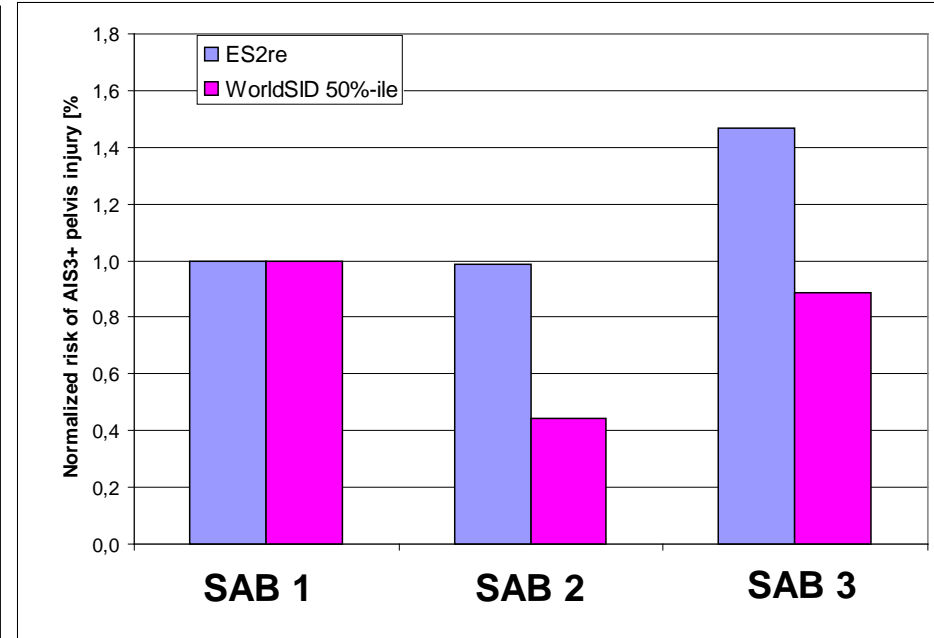
Sled test Euro NCAP Pole: 3 different SAB concepts

Pole sled: Normalized risk: AIS3+

Thorax

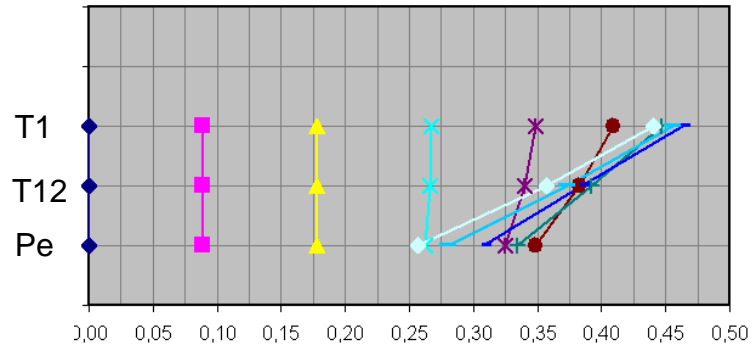


Pelvis



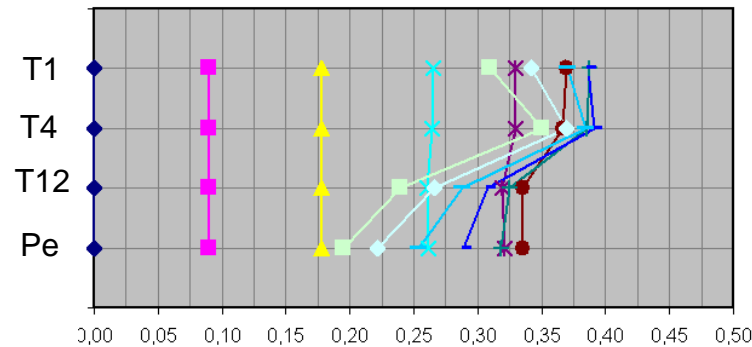
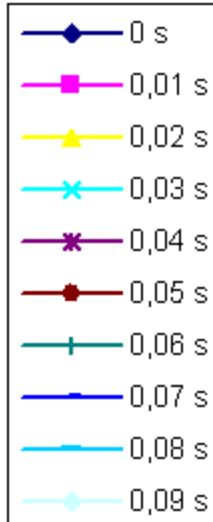
WS50%-ile Dummy kinematics (per airbag type)

Global coordinates (shows total dummy travel)



SAB 1

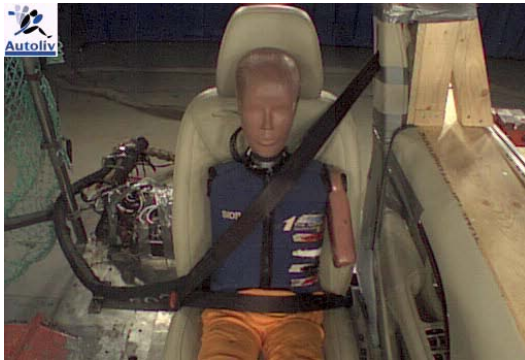
ES2re



SAB1

WS50%-ile

High severity MDB SID2s & WS5%-ile



	Head Acc. [g]	Shoulder Dy [mm]	Thorax Dy [mm]	Thorax VC	Abdomen Dy [mm]	Abdomen VC	Low Spine Acc. [g]	Pubic Force [kN]	Pelvis Acc. [g]
SID2s	63	52*	53	1,08	26	0,78	142	0,2	82
WS 5%-ile	60	51	23	0,19	18	0,11	73	N/A	49

*Flat top

High severity MDB – Full-scale test

Rear-seat

- No pelvic load measurement

Dummy position	Left rear passenger			
Test number	Sid2s	Injury risk	WorldSID 5%	Injury risk
Restraint	No	AIS3+ [%]	No	AIS3+ [%]
HIC₁₅	515	5,1	677	10,3
Neck tension [kN]	0,308		0,462	
Neck compression [kN]	0,262		0,959	
Peak deflection [mm]	55,1	93,7	46,0	74,9
Average deflection [mm]	46,1	78,6	40,3	61,8
V*C [m/s]	1,29		1,08	
Shoulder deflection [mm]	56,2		49,0	
Iliac force (left) [kN]	1,4			
Acetabulum force (left) [kN]	3,57			
Comb. acetabulum and iliac force [kN]	4,97			

Conclusions

WorldSID – good tool for evaluating overall side impact occupant protection.

- Spine kinematic
- Bi-lateral loading
- Ability to measure low and high crash severities
- Different response from different side airbag concepts

Specific points of interest:

- Rib rotation
- Shoulder kinematics

Thank you!



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